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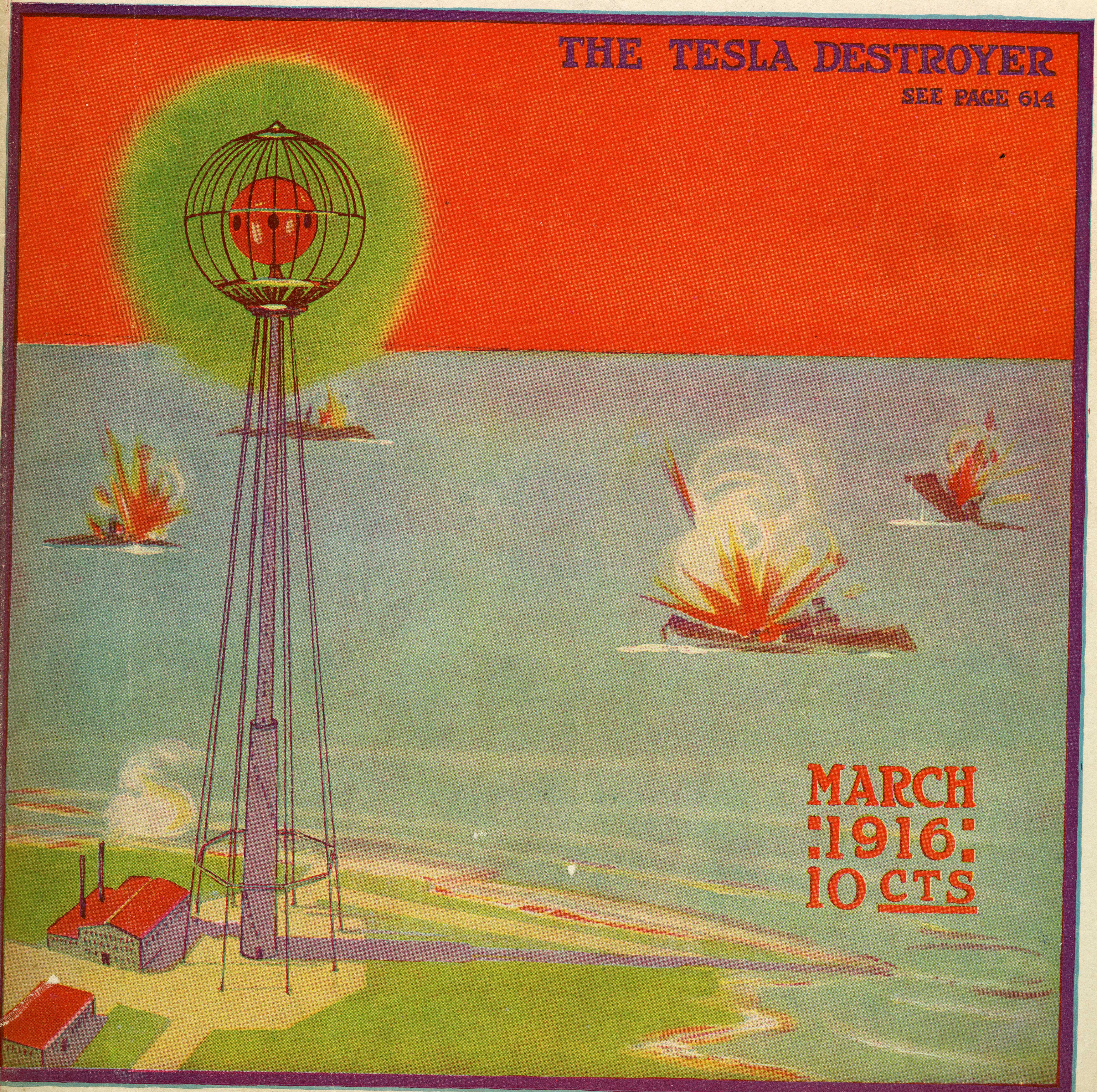

THE TESLA DESTROYER

SEE PAGE 614

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LARGEST CIRCULATION OF ANY ELECTRICAL MAGAZINE

The Tesla High Frequency Oscillator

By H. Winfield Secor, E.E.

TESLA, probably the highest authority in high frequency electrical engineering to-day, has not been dreaming these past few years, although we have not heard much from him, except through the daily newspapers, which now and then publish some world-startling interview describing a "marvelous" Tesla wave with which it is possible to communicate with Mars and several hundred other astounding stunts that the winner of the Noble physics prize probably never even thought of, much less attempted to accomplish.

Most of our readers have, no doubt, seen pictures of the famous Tesla wireless tower located at Shoreham, Long Island, and which structure has involved the expenditure of a vast sum of money. From this lofty structure, which was designed in the neighborhood of 20 years ago by Dr. Tesla and his associates, there was to be propagated an electric wave of such intensity that it could charge the earth to such an extent that the effect of the wave or charge could be felt in the utmost confines of the globe.

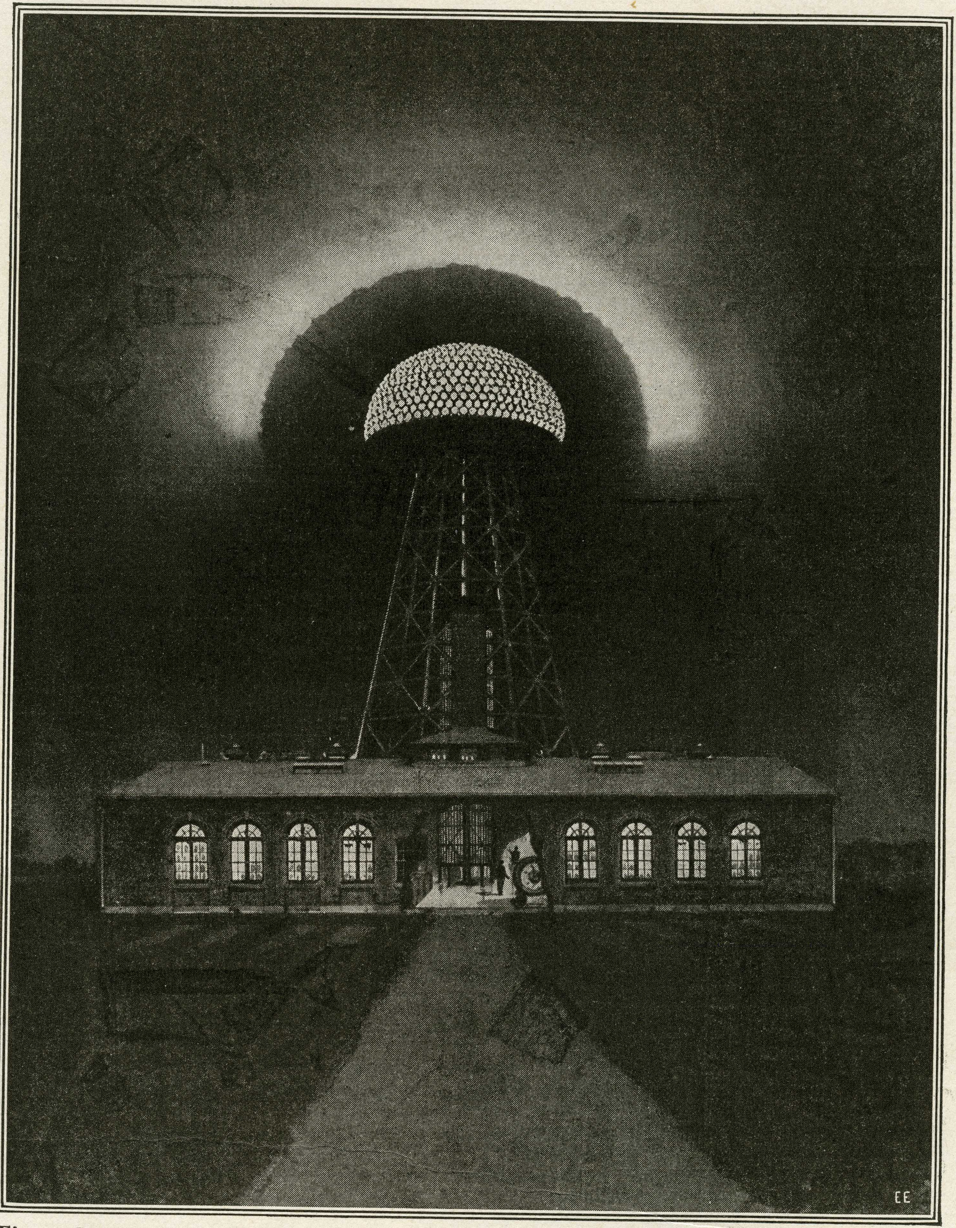

Fig. 1. Probable Appearance of the Wonderful Tesla Oscillator Tower at Night—It Is Located at Shoreham, L. I., and Is Intended for Radiating Electrical Energy in the Form of High Frequency Waves Propagated Thru the Earth Itself—Tower Stands 185 Feet High.

Our front cover illustration shows the Tesla tower in (theoretical) operation and, in line with some of the latest statements from this marvelous man, there may be perceived several dreadnoughts being blown to atoms, which is due to the high tension electric wave sent out from this center of vast electrical activity. Tesla, for obvious patent reasons, does not go into details just how whole fleets of a hostile navy can be destroyed in this way by means of powerful electric waves, but quite possibly he has in mind the fact that the latter can be tuned, undoubtedly, to a particular wave of certain frequency and power to accomplish this result when liberated from such a mighty station or oscillator as that located on Long Island. Such ships as the great steel shell dreadnoughts of to-day would, of course, have a large electrical capacity and this would help out the Tesla theory which covers the transmission and reception of an electric wave of sufficient intensity to do great good or damage, as the case might be.

The illustration on the front cover of this issue shows future possibilities which may be developed on the Tesla theory as a foundation. The location of the oscillator tower, from which the electrical energy is transmitted, and also the position of the war vessels being blown up are not to be considered literally in the way they are here shown. As a matter of fact, the enemy could soon shell the tower down, and hence it becomes evident that if this system is ever perfected and applied practically, the elevated radio energy transmitting station will have to be placed at a considerable distance inland. Again, as this wireless energy can be transmitted hundreds and even thousands of miles without any appreciable loss, according to Tesla's beliefs and statements, no disadvantage or inefficiency would be incurred by so locating the tower away from the coast; but conjointly, on this theory, the invading fleet of war vessels could be destroyed when they were still several hundred miles off shore. Hence, it would be impossible for them to hurl projectiles this distance. Also presumably this method of detonating the powder magazines of the war vessels could be applied to similar containers of high explosives on land, such as those carried by the heavy artillery corps of an invading army.

Further, it may be said that Tesla, all in all, does not believe in the modern Hertzian wave theory of wireless transmission at all. Several other engineers of note have also gone on record as stating their belief to be in accordance with Dr. Tesla's. More wonderful still is the fact that this scientist promulgated his basic theory of *earth current* transmission a great many years ago in some of his patents and other publications. Briefly explained, the Tesla theory is that a wireless tower, such as that here illustrated and specially constructed to have a high capacity, acts as a huge electric condenser. This is charged by a suitable high frequency, high voltage apparatus and a current is discharged into the earth periodically and in the form of a high frequency alternating wave. The electric wave is then supposed to travel through the earth along its surface shell and in turn to manifest its presence at any point where there might be erected a similar high capacity tower to that above described.

A simple analogy to this action is the following: Take a hollow spherical chamber filled with a liquid, such as water; and then, at two diametrically opposite points, let us place, respectively, a small piston pump, such as a bicycle pump, and an indicator, such as a pressure gauge. Now, if we suck some of the water into the pump and force it back into the ball by pushing on the piston handle, this change in pressure will be indicated on the gauge secured to the opposite side of the sphere. In this way the Tesla earth currents are supposed to act.

The patents of Dr. Tesla are basically quite different from those of Marconi and others in the wireless telegraphic field. In the nature of things this would be expected to be the case, as Tesla believes and has designed apparatus intended for the *transmission of large amounts of electrical energy,* while the energy received in the transmission of intelligence wirelessly amounts to but a few millionths of an ampere in most cases by the time the current so transmitted has been picked up a thousand miles away. In the Hertzian wave system, as it has been explained and believed in, the energy is transmitted with a very large loss to the receptor by electromagnetic waves which pass out laterally from the transmitting wire into space. In Tesla's system the energy radiated is not used, but the current is led to earth and to an elevated terminal, while the energy is transmitted by a process of conduction. That is, the earth receives a large number of powerful high frequency electric shocks every second, and these act the same as the pump piston in the analogy just cited. These electrical impulses or shocks given to the earth are to be picked up at receiving stations by erecting a suitable capacity in the form of a metallic tower, as will be described more in detail hereafter.

Quoting from one of Tesla's early patents on this point: "It is to be noted that the phenomenon here involved in the transmission of electrical energy is one of *true conduction* and is not to be confounded with the phenomena of *electrical radiation* which have heretofore been observed, and which, from the very nature and mode of propagation, would render practically impossible the transmission of any appreciable amount of energy to such distances as are of practical importance."

He states further: "From my experiments and observations I conclude that with electromotive impulses not greatly exceeding 15,000,000 or 20,000,000 volts, the energy of many thousands of horse-power may be transmitted over vast distances, measured by many hundreds and even thousands of miles, with terminals not more than 30,000 to 35,000 feet above the level of the sea; and even this comparatively small elevation will be required chiefly for reasons of economy, and if desired it may be considerably reduced; since, by such means as have been described, practically any potential that is desired may be obtained and the currents through the air strata may be rendered very small, whereby the loss in the transmission may be reduced. It will be understood that the transmitting as well as the receiving coils, transformers, or other apparatus may be in some cases movable—as, for example, when they are carried by vessels floating in the air, or by ships at sea."

Tesla is not an idle dreamer, as many men are inclined to believe, but back in the year 1898 he succeeded, in some very elaborate tests carried out in Colorado, in producing high frequency electrical discharges, the like of which had never before been witnessed by man, nor have they been duplicated since, to our best knowledge. Some of these sparks measured 100 feet in length and produced a roar like the Niagara Falls. The multitude of mighty sparks and flashes produced a discharge so terrific that no human being could stay in the building in which they took place. Some of the sparks were as thick as a man's arm and others manifested even greater intensity. They were produced by a gigantic Tesla high frequency coil with which experimenters of to-day are more or less familiar in a small way. About 300 kilowatts were utilized in producing these discharges, which resembled actual lightning bolts and not imitation ones. The amperage measured 800 and the voltage was up in the millions. The illustration of these sparks, as well as Tesla's early work along this line, have been covered in previous issues of *The Electrical Experimenter*.

Regarding the Tesla tower on Long Island and the general engineering features of same, we may refer to his patent which covers the design of the high frequency apparatus of mastodonic design and capable of charging the structure at several million volts pressure. The external appearance of the Tesla generating plant and antenna support (185 feet high) are shown at Fig. 1. The huge high frequency step-up transformer is shown diagrammatically at Fig. 2.

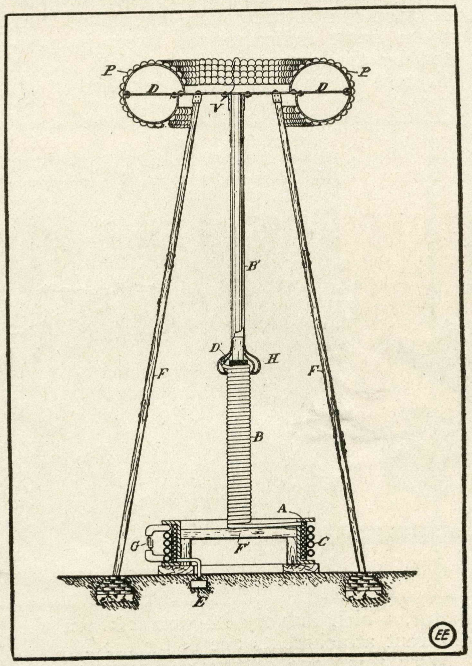

Fig. 2. Structure of the Tesla High Frequency Tower and Exciting Coils.

Referring to this great structure which involves several peculiar design features, we see at the upper extremity a large capacity, D. This is made up of a metal framework upon which there is mounted a vast number of hemi-spherical metal electrodes. These are advocated for the reason that the minimum electrical leakage will then ensue. As points, of course, discharge any high tension current as rapidly as possible, they are done away with, as this is exactly what Tesla does not desire to have take place in this instance. The complete electrode comprises a suitably shaped metallic ring and the half-spherical electrodes appear at P P. Hence, within a reasonably small space an extremely large electrical capacity is formed. This capacity rests upon insulating supports, which in turn are well insulated from the earth.

The high frequency exciting circuit comprises a massive coil, A, which is in close inductive relation with the primary winding C, one end of which is connected to a ground plate, E. The other end of the coil is led through a separate self-induction and auto-transformer coil, B, and the metallic cylinder B^1 to the terminal D. At the apex of the mast the connection with D is to be made at or near the center, Tesla specifies, in order to secure a symmetrical distribution of the current. Otherwise, when the frequency is very high and the flow of large volume, the performance of the apparatus might be impaired. The primary C is excited in any desired manner, from a suitable source of current G, which may be an alternator or condenser, the important requirement being that the resonant condition is established; that is to say, that the terminal D is charged to the maximum pressure developed in the circuit.

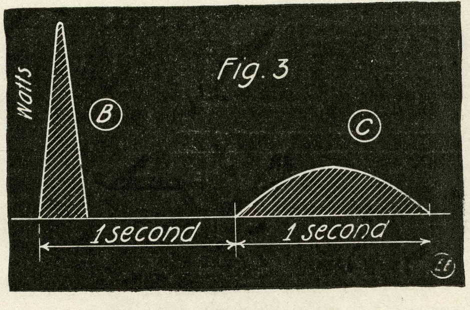

Fig. 3. Diagram Showing How the Rate at Which Energy Is Dissipated Increases as the Time Element Decreases.

The adjustments should be made with particular care when the transmitter is one of great power, not only on account of economy, but also in order to avoid danger. It has been shown that it is practicable to produce in a resonating circuit as E A B B D immense electrical activities, measured by *tens and even hundreds of thousands of horsepower,* and in such a case, if the points of maximum pressure should be shifted below the terminal D, along coil B, *a ball of fire* might break out and destroy the support F or anything else in the way. An induced earth current out of phase with a "tower capacity" current meeting at any point along the coil, etc., would buck each other and so balls of fire could be produced; the instantaneous value of the energy so involved being truly astonishing. For the better appreciation of the nature of this danger it should be stated that the destructive action may take place with inconceivable violence. This will cease to be surprising when it is borne in mind that the entire energy accumulated in the excited circuit (instead of requiring, as under normal working conditions, one-quarter of the period or more for its transformation from static to kinetic form) may spend itself in an incomparably smaller interval of time, *at a rate of many millions of horsepower.* The accident is likely to occur when, the transmitting circuit being strongly excited, the impressed oscillations upon it are caused, in any manner more or less sudden, to be more rapid than the free oscillations.

It may seem quite impossible for many of our readers to comprehend the large figures cited by Tesla with regard to the voltage and horsepower liberated or propagated from such a structure as he has designed. However, by referring to Fig. 3, this matter can be more readily understood. This diagram shows how a graphic curve, C, would appear for, say, 100 horsepower liberated or passing through a circuit for the time period of one second. Now consider that instead of this 100 horsepower of energy being allowed to pass along in normal fashion for a period of one second, that it is heaped up or liberated in about one-fifth of a second as at B. The horsepower or watts, let us say in this case, would be dissipated at a much higher intensity rate than was the case at C. In other words, the rate of dissipation in this instance would be 500 horsepower for one-fifth of a second instead of 100 horsepower for one second.

Now consider that a Tesla current as produced by an oscillatory discharge from condensers and the like take place in very small fraction of time, then Tesla's statements in his patent and aforementioned with regard to the production of hundreds of thousands of horsepower is not so fallacious at it may seem. In an interview with one of our editorial staff he has vouchsafed the information that the oscillator here pictured is supposed to be excited with an input of 300 kilowatts. The average person then begins to gasp for air. An input of only 300 kilowatts! How, then, could this tower be caused to oscillate and liberate energy at the rate of hundreds of

(*Continued on page* 663.)

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enclosed an air space around the boilers proper. The concentration value of this arrangement was 4½ to 1. The maximum pounds of steam generated was 12 pounds per 100 square feet of sunshine, or the equivalent, to 183 square feet per brake horsepower. The best hours' run developed, at atmospheric pressure, 1,442 pounds of steam. Hence (allowing 22 pounds steam per brake horsepower) the maximum output for an hour was 55.5 horsepower (about ten times better than any previous results). This means 63 brake horsepower per acre of land occupied by the plant. Moreover, no marked reduction in the horsepower produced was noticeable in the early hours of the morning or in the late hours of the afternoon.

The engineers of the concern which made these tests at Meadi recommended that such solar plants were feasible and practical and that undoubtedly they would be a very good thing in such arid regions for irrigation purposes. One argument brought against them, however, was that the power would not be available in cloudy weather, but then the irrigation would not be necessary, was the reply.

Thus the fight goes on between Dame Nature and the scientists. Whether we shall ever have an efficient solar boiler and engine is a problem worth thinking about and a very interesting one at that, as we possess no greater source of natural energy, to be had without taxation or special leases from some money-grabbing coal, oil or other baron, than that of the sun. Some day we may be able to derive all necessary light and power, for our homes at least, by means of a solar-electric plant located on the roof, and who shall say that we must be taxed for utilizing such energy?

THE TESLA HIGH FREQUENCY OSCILLATOR.

(*Continued from page* 615.)

thousands of horsepower? However, this figures out better than might be expected offhand. With an input of 300 kilowatts at the Tesla coil primary exciting such a structure and considering that this amount of energy is discharged through the earth in six-thousandths (.006) of a second, then the rate of liberation of the energy will be 120,000 horsepower.

Many perhaps would doubt that even with their small experimental high frequency sets, where a high frequency ammeter placed in the high frequency circuit may register but *1 ampere effective current,* yet an average maximum surge for the oscillation passing through the circuit may and often does reach the value of *over 116 amperes.* As the amplitudes of each succeeding high frequency alternation is less than the one preceding it, of course the first oscillations are much higher than the average amplitude just mentioned, and consequently the peak value of the current which flows through the electrode and into a person (who may happen to be connected in series with a 110-volt, 32 candlepower lamp for demonstration purposes) may reach a very much higher figure than 116 amperes.

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